Space Weather Technical Forecast

Issued on Monday, 29 January 2024 at 01:25 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Chance of G1/Minor Storms either late on 29 or 30 January due to the onset of a high speed stream. Chance of isolated M-flares.

Analysis of Space Weather Activity over past 24 hours
Solar Activity: Low with only C-class flares observed. The strongest flare of the last 24-hours, a C3.4 at 28/2334UTC was from beyond the northeastern limb. AR3559 has also shown limited activity, with a C-class flare resulting in a CME which appears have been ejected to the northwest of the Sun. There are four sunspot regions in total, with AR3559 and AR3560 close to the western limb and appearing to be weakening. The other two regions are both weak. No Earth-directed CMEs have been observed on available imagery.

Solar Wind / Geomagnetic Activity: Solar winds started at ambient levels, but increased to slightly elevated levels from around 28/1630UTC, then reaching a peak of 490km/s at 28/2316UTC. Density also increased from below average to average levels around the same time, reaching a peak of 10ppcc at 28/2236UTC. Magnetic field strength has varied between moderate and weak levels reaching a peak of 12nT at 28/0936UTC. The north-south component, Bz started the period mainly weakly positive, but has been predominantly weakly negative since around 28/1330UTC. Phi angle started positive (away from the Sun) but switched to a positive orientation from 28/1026UTC. Geomagnetic activity started Quiet, but increased to Unsettled by the end of the period.

Energetic Particles / Solar Radiation: GOES18 high energy (greater than 10MeV) proton flux was at background. GOES16 high energy (greater than 2MeV) electron flux was at background. The associated 24-hour fluence was well below the Active (1e8 integrated pfu) threshold on a generally steady trend. At 29/0000UTC the 24-hour integrated fluence observation was 1.16e6 integrated pfu.

Four-Day Space Weather Forecast Summary
Solar Activity: Low activity is forecast, with an isolated M-class flare risk. This is initially from the two complex regions in the west, but is increasingly likely to be due to the regions rotating onto the eastern limb.

Solar Wind / Geomagnetic Activity: No CMEs are forecast to affect the Earth, although a glancing blow is currently believed to be perturbing the near-Earth environment. A high speed stream from coronal hole 94 is then forecast to affect the Earth from either late on 29 or during 30 January. The effects of this are likely to gradually wane towards the end of the period. Geomagnetic activity is forecast to start mainly Quiet to Unsettled, with isolated Active intervals. There is then a risk of G1/Minor Storm intervals either late on 29 or during 30 January due to the onset of the high speed stream.

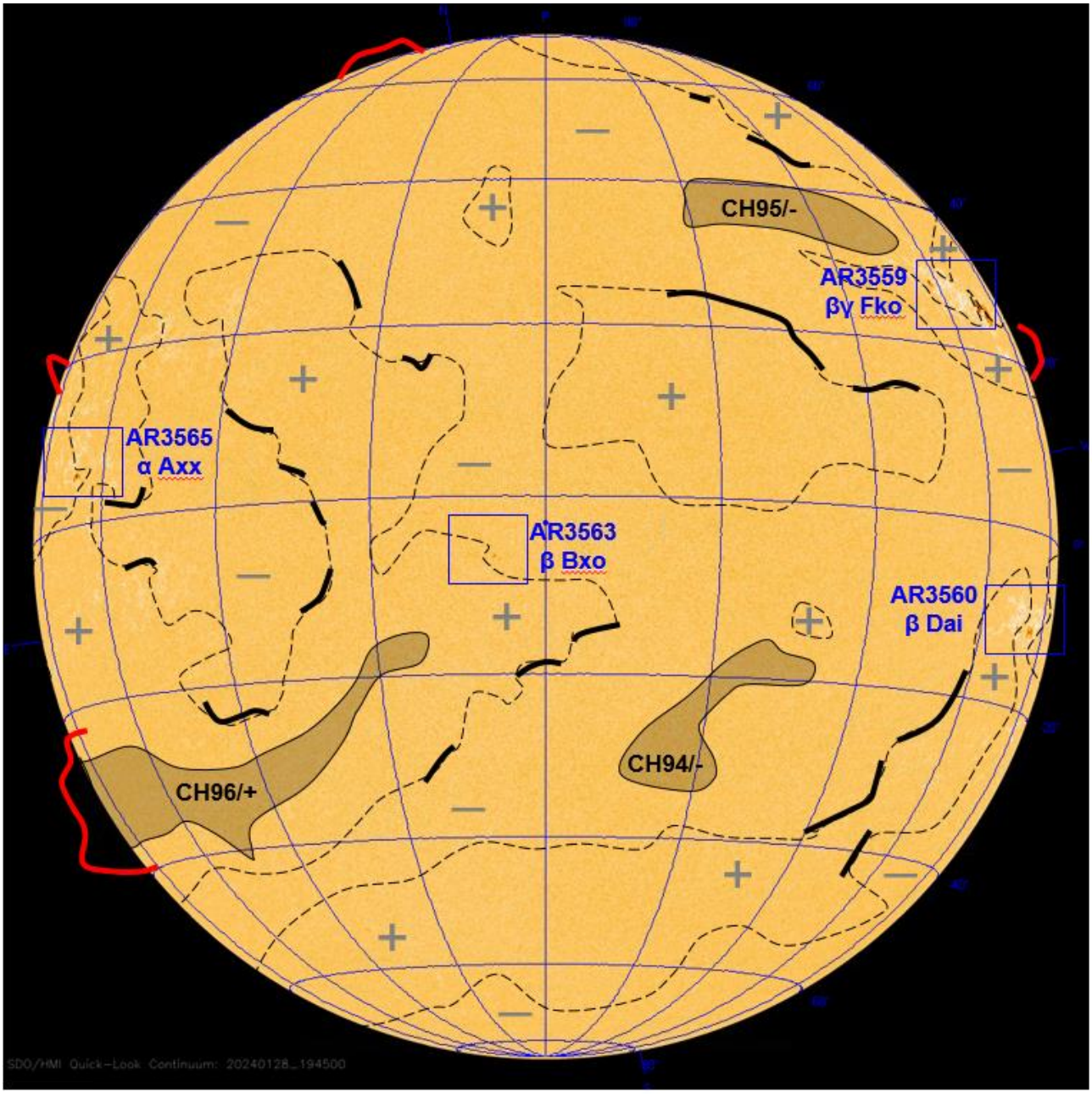
Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2024. All Rights Reserved.

Met Office Space Weather Technical Forecast

Energetic Particles / Solar Radiation: High energy proton flux is expected to remain at background with only a slight chance of rising to in response to any notable flares from the sunspots near or just over the west limb. High energy electron flux (greater than 2MeV) is expected to gradually increase towards the high threshold due to effects of the high speed stream. The associated electron fluence is forecast start trending towards the Active threshold, with a very slight chance of exceeding this level.

Figure 1. Solar Analysis Valid 28/2000UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2024. All Rights Reserved.

Geomagnetic Storms:
No CMEs are currently expected to affect the Earth through the forecast period.

Solar wind speeds are currently slightly elevated at around 500km/s on a rising trend. This increase is apparent on both ACE and DSCOVR confirming that it is a real phenomenon. This could potentially be an early onset of coronal hole 94, with speeds of 500km/s, a weak connection to coronal hole 95 in the north or a weak CME passage.

Based on the correlation between density and speed increases, along with discontinuities in the magnetic field, a weak, glancing CME passage is considered to be the most likely source of this increase, The steady, rather an sharp increase in speeds in this scenario could be due to the CME glancing the magnetic field, with the observational spacecraft passing close to the edge of the feature. Assuming that the current increases are due to a CME, a high speed stream from coronal hole is forecast to connect with Earth either late on 29 or during 30 January with speeds estimated at around 500km/s. This is based around this recurrent feature appearing stronger on this rotation with speeds around 450-500km/s observed previously. There is also the risk of a CIR ahead of the high speed stream, which may initially enhance geomagnetic activity.

Geomagnetic activity may start mainly Quiet to Unsettled with a risk of Active intervals due to recent enhancements. Further increases are then forecast either late 29 or during 30 January as the Earth is forecast to connect to the coronal hole high speed stream. Effects are then likely to subside later in the period, falling back to Quiet to Unsettled levels.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	20	30	5	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2024. All Rights Reserved.

Figure 2: Recent solar wind observations at L1 and DSCOVR

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

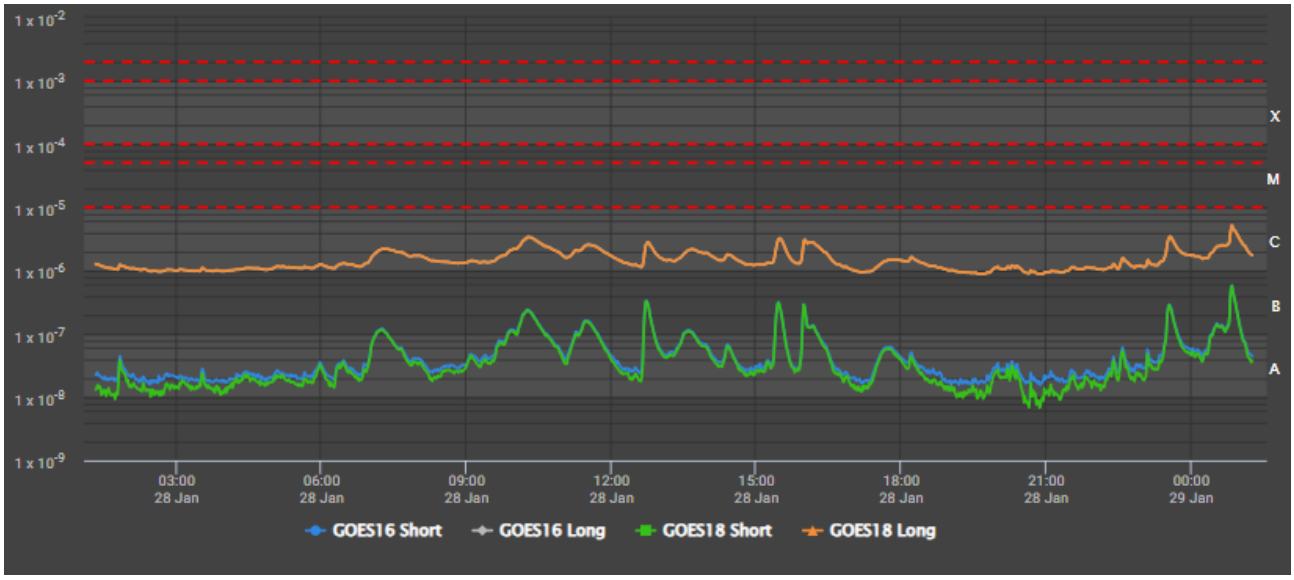
© Crown Copyright 2024. All Rights Reserved.

Radio Blackouts - X-Ray Flares:
AR3559 and AR3560 are now approaching the western limb and are demonstrating muted and sporadic C-class activity. The other two sunspot regions on the disc are small and are not considered to present a significant risk. There is a possible rise in activity for regions moving across the eastern limb, considering the bright flux evident on SDO imagery and a recent C3.4 flare from just beyond the northeast limb. There have also been a series of farsided CMEs through the last few days, which could be indicative of complex active regions.

Low activity is forecast, with a continuing risk of M-class flaring. The consistent chance of M-class flares considers the decline of the two previous active regions, with the increase in risk from regions rotating across from the far side.

X Ray Flares Probability	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	R1-R2 M Class	No	30	30	30	30
Very Active	R3 to R5 X Class	No	1	1	1	1

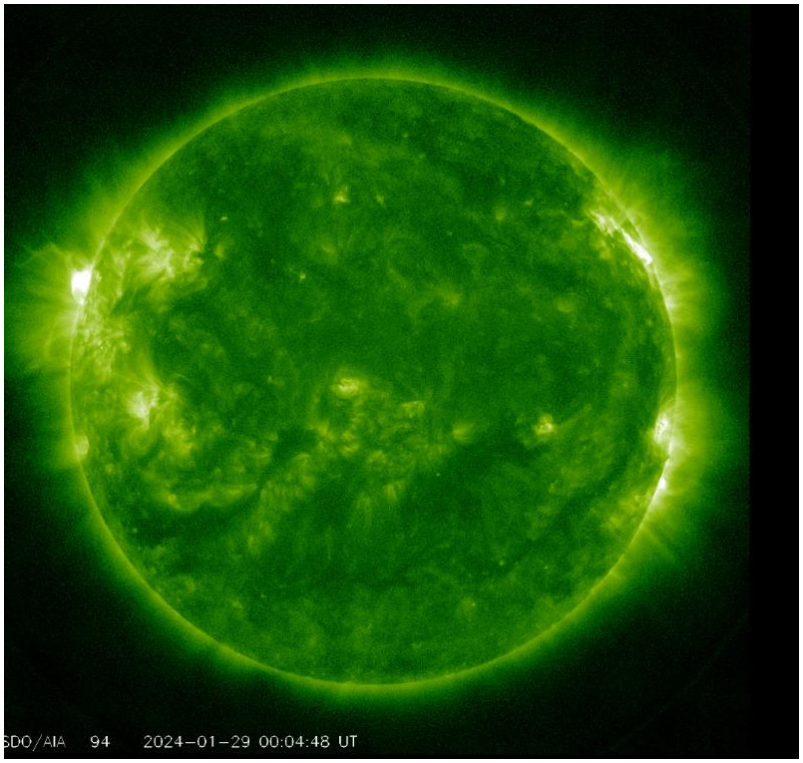
Figure 3: GOES16 X-Ray flux



Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2024. All Rights Reserved.

Figure 4: SDO AIA-94 imagery, with the bright flare evident close to the northeast limb



Solar Radiation Storms - (High Energy Protons):

GOES18 high energy (greater than 10MeV) proton flux is at background. Despite AR3559 showing signs of weakening, there remains a slight chance of any notable flares from this region and possibly from AR3560 increasing the observed flux at Earth, with a very slight and reducing chance of reaching the S1/Minor Radiation storm level.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	5	2	2	2
Very Active	**≥ S3 ***	No	1	1	1	1

* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2024. All Rights Reserved.

High Energy Electrons Event (≥ 2MeV):
High energy electron flux (greater than 2MeV) may begin to increase through the period, as the recent solar wind enhancement and then the expected coronal hole high speed stream enhancements recharge the radiation belts. The magnitude of this charging is uncertain, but there is an increasing chance of reaching the high threshold on diurnal highs through the period. Although geomagnetic activity and increases in solar wind speeds may distort the belts and also reduce observed electron populations temporarily, the trend is likely to be upwards overall.

Electron fluence values are forecast to reflect the increase in the electron flux values, with an increased likelihood of approaching the Active threshold.

GEO Electron Environment	Level ($cm^{-2}\ sr^{-1}\ day^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ $1x10^{8}$	No	1	1	1	10
Very Active	≥ 2 MeV ≥ $1x10^{9}$	No	1	1	1	1

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2024. All Rights Reserved.